As to what may be the cause of earth-tremors I am not prepared to offer a definite opinion; but, inasmuch as their association with barometric fluctuations renders it possible that in their occurrence they may also be associated with the escape of fire-damp, about which we have so little knowledge of practical value, it seems impossible that their study should be neglected.

Whether the results of such a study would be of practical value to the miner is not known, but that results of scientific value would be obtained is indisputable.

As the making of such observations are neither a matter of trouble or serious expense, I sincerely trust that they may be undertaken. On some future occasion I hope to describe the experiments which I made with one of these instruments on the summit of Fujiyama (13,365 feet), where movements were of a very marked and decided character.

Tokio, Japan JOHN MILNE

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 18.—"The Removal of Micro-organisms from Water." By Percy F. Frankland, Ph.D., B.Sc., F.C.S., Associate of the Royal School of Mines.

The author has investigated the efficiency, as regards the removal of micro-organisms, of methods of water-purification depending upon

(*a*) Filtration
(*b*) Agitation with solid particles
(*c*) Precipitation.

The method of investigation consisted in determining the number of organisms present in a given volume of the water before and after treatment, the determinations being made by Koch's process of gelatine-culture on glass-plates.

Treatment of Water by Filtration.—The filtering materials examined were greensand, silver sand, powdered glass, brick-dust, coke, animal charcoal, and spongy iron. These materials were all used in the same state of division, being made to pass through a sieve of 40 meshes to the inch, and in columns of 6 inches in depth. The following results were obtained:—

	No. of organisms in 1 c.c. of water before filtration	Ditto after filtration
Greensand	80	0
ditto (after 13 days)	8,193	1,071
ditto (after 1 month)	1,281	779
Silver Sand	11,232	1,012
Powdered Glass	11,232	792
Brickdust	3,112	732
ditto (after 5 weeks)	5,937	406
Coke	3,112	0
ditto (after 5 weeks)	5,932	86
Animal Charcoal	very numerous	0
ditto (after 12 days)	2,792	0
ditto (after 1 month)	1,281	6,958
Spongy Iron	80	0
ditto (after 12 days)	2,792	0
ditto (after 1 month)	1,281	2

Thus greensand, coke, animal charcoal, and spongy iron were at first successful in removing all organisms from the water passing through them, but after 1 month's continuous action this power was in every case lost, the improvement still effected, however, by spongy iron and coke was very great indeed, whilst the greensand and brickdust were much less efficient, and the number of organisms in the water that had been filtered through animal charcoal was greater than in the unfiltered water.

Treatment of Water by Agitation with Solid Particles.—Water was agitated with various substances (in the same state of division as above) and after the subsidence of the suspended particles, the number of organisms in the water before and after treatment was determined. 1 grm. of substance was in nearly each case shaken up with 50 c.c. of water. The agitation was in nearly all cases continued for 15 minutes, but the duration of subsidence was varied according to the length of time which it required for the water to become clear. The following results were obtained:—

	No. of organisms in 1 c.c. of water before treatment	Ditto after treatment
Spongy Iron (1 minute agitation, ½ hour subsidence; 5 grms. used)	609	28
Spongy Iron (15 minutes' agitation, ½ hour subsidence; 5 grms. used)	609	63
Chalk (15 minutes' agitation, 5 hours' subsidence)	8,325	274
Animal Charcoal (15 minutes' agitation, 5 hours' subsidence)	8,325	60
Coke (15 minutes' agitation, 48 hours' subsidence)	Too numerous to be counted	0
China Clay (15 minutes' agitation, 5 days' subsidence)	—	Too numerous to be counted

In order to ascertain whether subsidence alone would diminish the number of organisms contained in the upper strata of water, bottles containing infected water were allowed to remain at perfect rest, and then the upper layers in the several bottles were tested for organisms at different intervals of time. Thus:—

Hours of rest	No. of organisms found in 1 c.c. of water
0	1,073
6	6,028
24	7,262
48	48,100

Thus, without agitation with solid particles and subsequent subsidence of the latter, there is no diminution, but on the contrary an increase in the number of organisms in the upper strata of water.

Treatment of Water by Chemical Precipitation.—The effect of "Clark's process" in removing organisms from water was investigated both in the laboratory and on the large scale. In the laboratory experiments the following results were obtained:—

	Organisms in 1 c.c.
Untreated water	85
ditto (after 18 hours' rest)	1,922
Water after Clark's process and 18 hours' subsidence	42

In a second series of experiments the following results were obtained:—

	Organisms in 1 c.c.
Untreated water	37
ditto (after 21 hours' rest)	42
ditto (after 48 hours' rest)	298
Water after Clark's process and 21 hours' subsidence	22
ditto (after 48 hours' subsidence)	166

On the large scale the efficiency of the process was examined at the Colne Valley Waterworks, Bushey:—

	Organisms in 1 c.c.
Hard water	322
Water after softening and 2 days' subsidence	4

A recent modification of Clark's process devised by Gaillet and Huet was also examined:—

	Organisms in 1 c.c.
Hard water	182
Soft water	4

Thus a very great reduction in the number of organisms present in a water may be effected by submitting it to Clark's process. It appears also that the clear water should be removed as rapidly as possible from the precipitated carbonate of lime, as otherwise the organisms may become again distributed through the water.

Micro-organisms in Potable Water.—The number of organisms in natural waters of various origin has been determined by the author, who appends the results of a monthly examination, in this respect, of the various waters supplied to London during the first three months of the present year:—

	1885 No. of organisms in 1 c.c. of water		
	Jan.	Feb.	March
Chelsea	8	23	10
West Middlesex ...	2	16	7
Southwark	13	26	246
Grand Junction ...	382	57	28
Lambeth	10	5	69
New River	7	7	95
East London	25	39	17
Kent	10	41	9

General Conclusions.—Of the substances experimented with only greensand, coke, animal charcoal, and spongy iron were found to wholly remove the micro-organisms from water filtering through them, and this power was in every case lost after the filters had been in operation for one month. With the exception of the animal charcoal, however, all these substances, even after being in action for one month, continued to remove a very considerable proportion of the organisms present in the unfiltered water, and in this respect coke and spongy iron occupy the first place.

The results obtained by agitating water with various solid materials show that a very great reduction in the number of suspended organisms may be accomplished by this mode of treatment, and the complete removal of all organisms by agitation with coke is especially worthy of notice.

Again, the results obtained with Clark's process show that we possess in this simple and useful mode of treating water a means of greatly reducing the number of suspended organisms.

Thus, although the production in large quantities of sterilised potable water is a matter of great difficulty, involving the continual renewal of filtering materials, there are numerous and simple methods of treatment which secure a large reduction in the number of organisms present in water.

Physical Society, June 27.—Prof. Guthrie, President, in the chair.—Dr. Ramsay, Messrs. T. Hands, F. W. Sanderson, W. A. Shenstone, and T. H. Nalder were elected Members of the Society.—The following communications were read:—On the specific refraction and dispersion of the alums, by Dr. J. H. Gladstone. The refraction, dispersion, and specific gravity of nineteen different alums in the crystalline form were published by M. Charles Soret, of Geneva, in the *Comptes rendus* for last November. These, together with some additional data from Soret, Topsöe, and Christiansen, were employed by the author for comparison with certain experimental results of his own and of Kannonikof. In this way additional proof was obtained that a salt has the same specific refraction, whether it be crystallised or dissolved, and that the refraction equivalent of a compound body is the sum of the refraction equivalents of its components. The refraction equivalents of the alkalies in these alums are in the following ascending order—sodium, potassium, ammonium, rubidium, methylamine, calcium, and thallium; and of the other metals—aluminium, chromium, and iron. This is in accordance with what was previously known, but Soret's observations do not afford the means of determining the equivalents more accurately than before. The refraction equivalents of iridium and gallium were determined for the first time, giving respectively 17·4 and 14·8. The specific dispersion of the same compounds, measured by the difference between the specific refractions for the lines A and C, was also examined. The differences of dispersion are much greater comparatively than the differences of refraction. The order was also determined, but not the actual dispersion equivalents of the different elements.—On a form of standard Daniell cell, and its application for measuring large currents, by Dr. J. A. Fleming. The author first referred to the careful and thorough investigation of the circumstances affecting the electromotive force of Daniell's and allied cells by Dr. Alder Wright. He then described a form of all that had been found most convenient and reliable in practice. It consists of a U-tube in the two limbs of which are the two solutions of sulphate of copper and sulphate of zinc of the same specific gravity. Electrodes consisting of freshly electro-deposited copper and pure zinc that has been twice distilled dip into the two limbs. The E.M.F. of this cell is 1·102, and the variation of E.M.F. with temperature is practically *nil*.—On the phenomenon of molecular radiation in incandescent lamps, by Dr. J. A. Fleming. Some years ago Dr. Fleming had called attention to a phenomenon in incandescent lamps very analogous to that of discharge in high vacua observed by Mr. Crookes. The inner surface of the lamp-glass was sometimes found to be coated with a deposit of carbon, with the exception of a clear line marking the intersection of the glass with the plane of the loop, and being in fact a shadow of the loop apparently caused by an emission of matter from the terminals. Dr. Fleming has since found how to produce this appearance at pleasure by passing a very strong current momentarily through a lamp, and has succeeded in obtaining similar deposits of various metals that had been used as terminals. These deposits show colours by transmitted light, and as a general result the author concludes that red metals such as gold and copper appear green by transmitted light, whereas white metals like silver and platinum appear brown, a conclusion which, however, was challenged by Capt. Abney in the discussion ensuing.—On problems in networks of conductors, by Dr. J. A. Fleming.—Lecture experiments on colour mixtures, by Capt. Abney. The apparatus employed by Capt. Abney is a modification of Maxwell's colour-box: the spectrum, instead of being formed upon a screen, is received upon a convex lens which forms an image of the face of the prism upon a screen. If all the light from the prism falls upon the lens this image is colourless, but by interposing a screen with a slit in the spectrum close to the lens, so as only to allow light of a given colour to fall on the lens, the image appears coloured with that light. By using two or more slits different lights may be mixed in any required proportions.—On stream-lines of moving vortex-rings, by Prof. O. J. Lodge. The communication described a method of drawing vortex stream-lines, consisting in superposing uniform motion represented by a series of parallel lines upon the lines of a stationary vortex as given by Sir W. Thomson in his memoir on vortex motion, and joining up the corners of the quadrangles so formed. This operation is very simple, and by its application a number of the more remarkable properties of vortex-rings may be obtained, the general analytical investigation of which involves mathematical methods of the highest order. Drawings were exhibited showing the nature and behaviour of a single vortex-ring moving with different velocities, a vortex-ring approaching a large distant obstacle, the chase of two unequal rings, and many other cases.—On the thermo-electric position of carbon, by Mr. J. Buchanan. It having been observed that the carbon filaments of incandescent lamps usually gave way at the negative end, experiments were instituted to find if the destruction could be due to the "Peltier effect" causing a local generation of heat. Observations on a platinum-carbon thermo-couple showed that a generation of heat would result from a current passing from carbon to platinum, but the effect was too small to account for the observed phenomenon. It was found that a couple of carbon-iron rose considerably in E.M.F. by maintaining the hot joint for some time at 250° C.—On some further experiments with sulphur cells, by Mr. Shelford Bidwell. The paper contains (1) a description of a class of cells which give a constant voltaic current, the electrolyte consisting of a solid metallic sulphide; (2) an explanation of the unilateral conductivity exhibited by selenium and by sulphur cells; and (3) a description of a cell which gives, as the result of passing a current through it, a current in the same direction as the primary current.

EDINBURGH

Mathematical Society, July 10.—Mr. A. J. G. Barclay, president, in the chair.—Mr. R. E. Allardice gave an account of a paper by Mr. Charles Chree on physical applications of polar co-ordinates to the displacement of elastic solid and fluid bodies, and contributed some notes of his own on solid geometry.—Mr. J. S. Mackay submitted a paper by Mr. Robert J. Dallas on the method of orthogonal projection.—Mr. A. Y. Fraser, the hon. secretary, and Dr. Rennet, of Aberdeen, were appointed by the Society to represent it at the ensuing meeting of the British Association.—The president, in his closing remarks, stated that the membership of the Society at the end of its first session was 58, at the end of its second 92, and now, at the end of its third, 147.

PARIS

Academy of Sciences, July 6.—M. Bouley, president, in the chair.—New methods for determining the absolute co-ordinates of the polar stars without the necessity of ascertaining the instrumental constants, by M. Lœwy.—On the movement of a heavy revolving body fixed at a point in its axis, by M. G. Darboux.—On some new properties of the differential parameter of the second order for the functions of any number of independent variables, by M. Haton de la Goupillière.—A reply to

M. Mascart's recent note on the great movements of the atmosphere, by M. Faye.—Researches on vegetation: on the carbonates in living plants, by MM. Berthelot and André. In this paper the authors explain the methods followed by them in determining the quantity of the simple organic salts now known to be largely, if not universally, diffused throughout the vegetable kingdom.—Anatomy and physiology of Phœnicurus, a remarkable parasite found largely associated with certain mollusks, by M. de Lacaze-Duthiers.—On the homography of two solid bodies, by M. Sylvester.—Report on the experiments made in Holland and Belgium on an application of the large movable tubes of the hydraulic system constructed at the sluices of the Aubois; further modifications of that system, by M. A. de Caligny.—Spectrum of ammonia obtained by reversal of the induced current, by M. Lecoq de Boisbaudran.—A process of prophylactic inoculation against splenetic or charbon fever, by M. A. Chauveau. The peculiarity of this process consists in the method adopted for attenuating the cultivated virus, which is effected by means of compressed oxygen. Three points are established: (1) that it suffices to inoculate animals a single time in order efficiently to protect them both from experimental inoculations with strong, unattenuated virus and from the effects of spontaneous contagion; (2) that the virus attenuated by means of compressed oxygen is as harmless as that obtained by other methods constituting what is known as the first charbon vaccine; (3) that the most attenuated virus continues still active and serviceable long after its preparation.—Remarkable solar protuberances observed at diametrically opposite points of the disk on June 26, in Paris, by M. E. L. Trouvelot.—On some formulas in the theory of left curves, by M. Ph. Gilbert.—On the reductive properties of pyrogallol; its action on the salts of iron and copper, by MM. P. Cazeneuve and G. Linossier. The authors' experiments establish a complete parallelism between the reactions of ferric and cupric salts.—On the action of acetic acid in decomposing the hyposulphites of sodium and potassium, by M. E. Mathieu-Plessy.—Description of a new method of quantitative analysis for cadmium, by MM. Ad. Carnot and P. M. Proromant.—A new process for detecting and rapidiy analysing small quantities of nitric acid in the air, water, earth, &c., by MM. Al. Grandval and H. Lajoux.—On the formation of large deposits of nitrates in Venezuela, the Andes, the Orinoco Basin, and other intertropical regions, by MM. A. Muntz and V. Marcano. From their observations the authors conclude that these nitrates have a purely animal origin, developed without the intervention of atmospheric electricity. Their position, the constant presence of large quantities of sulphates and of the nitrifying organism, combined with the study of the phenomena observed in deposits now in process of formation, all tends to exclude the recently advanced hypothesis of electric influences.—On the composition and fermentation of interverted sugar; a reply to M. Maumené, by M. Em. Bourquelot.—On the fermentation of the jéquirity plant, by MM. J. Béchamp and A. Dujardin.—On the production of the hydrate of crystallised magnesium (artificial brucite) and of the hydrate of crystallised cadmium, by M. A. de Schulten.—On the determination of the mineral group of zeolites in the absence of determinable crystalline forms, by M. A. Lacroix.—On a new group of felspar rocks in the district of Four-la-Brougue, Puy-de-Dôme, by M. F. Gounard.—On the position of some serpentine rocks on the road between Granada and Jaen in the north of the province of Granada, Spain, by M. W. Kilian.—On the augite and hornblende eruptive formations (diorites and serpentines) in the Sierra de Peñaflor, Andalusia, and on the genesis and dissemination of gold throughout these rocks, by M. A. F. Nogués.—Contributions to the study of the oolitic flora of West France, by M. L. Crié.—On the structure and growth of whalebone in the Balenopteræ, by M. Y. Delage.—On the structure and action of the stylets in the sting of the bee, by M. G. Carlet.—On the respective toxic properties of the organic and saline matters present in the urine, by MM. R. Lépine and P. Aubert.—Epilepsy of auricular origin: a contribution to the study of otopiesis (auricular compression), by M. Boucheron.—New metalloscopic processes applicable especially to cases of lethargy, catalepsy, and somnambulism, by M. Moricourt. The author shows that patients subject to these morbid affections are peculiarly sensitive to the action of metals, many cases having been successively treated by his new metallotherapic processes.—Clinical studies on the leprosy still surviving in the rural districts of Norway, by M. Paul Bert.—On the passage of pathogenic microbes from the mother to the fœtus, by M. Koubassoff.—M. Grandidier was elected a member of the Section for Geography and Navigation in place of the late M. Dupuy de Lôme.

SYDNEY

Royal Society of New South Wales, May 6.—Annual Meeting.—H. C. Russell, B.A., F.R.A.S., President, in the chair.—The report of the Council stated that 34 new members had been elected during the year, making the total on the roll 494. Sir G. B. Airy, K.C.B., F.R.S., and Prof. John Tyndall, F.R.S., had been elected Honorary Members in the room of Sir F. B. Barlee, K.C.M.G., and George Bentham, C.M.G., F.R.S., deceased. The sum of 380*l.* had been expended on books and periodicals during the year. The Clarke Memorial Medal for 1885 had been awarded to Sir J. D. Hooker, K.C.S.I., C.B., and the Society's Medal and a prize of 25*l.* to Mr. W. E. Abbott for his paper on the water-supply in the interior of New South Wales. The Society had presented its *Journal* to 313 kindred societies and institutions, and received 1147 volumes and pamphlets in return. The following papers had been read at its monthly meetings:—Presidential Address, by Hon. Prof. Smith, C.M.G.; the removal of bars from the entrances to our rivers, by W. Shellshear, A.M.I.C.E.; notes on gold, by Dr. Leibius, M.A.; some minerals new to New South Wales, by Prof. Liversidge, F.R.S.; the oven-mounds of aborigines in Victoria, by Rev. P. MacPherson, M.A.; notes on the trochoided plane, by L. Hargrave; a new form of actinometer, by H. C. Russell, B.A.; notes on some mineral localities in the northern districts of New South Wales, by D. A. Porter; notes on Doryanthus, by C. Moore, F.L.S.; water-supply in the interior of New South Wales, by W. E. Abbott; notes on a new self-registering anemometer, by H. C. Russell, B.A.; researches upon the embryology and development of the Marsupials, Monotremes, and Ceratodus, by W. H. Caldwell, M.A.—A *conversazione* was held on October 8 in the Great Hall of the University, attended by about 900 members and their friends. The Council had issued the following list of subjects with the offer of the Society's Bronze Medal and a prize of 25*l.* for each of the best researches, if of sufficient merit (to be sent in not later than May 1, 1886):—On the chemistry of the Australian gums and resins; on the tin deposits of New South Wales; on the iron ore deposits of New South Wales; list of the marine fauna of Port Jackson, with descriptive notes as to habits, distribution, &c. (to be sent in not later than May 1, 1887); on the silver ore deposits of New South Wales; origin and mode of occurrence of gold-bearing veins and of the associated minerals; influence of the Australian climate in producing modifications of diseases; on the Infusoria peculiar to Australia.—The Chairman delivered the Presidential Address, and the officers were elected for the ensuing year.

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